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John Derome

– Ambassador for forest monitoring in Europe

Memorial seminar
November 30th 2010, Rovaniemi, Finland

Liisa Ukonmaanaho, Kirsti Derome, Pasi Rautio and
Päivi Merilä (eds.)

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Abstract			
The memorial seminar of John Derome, “John Derome – Ambassador for forest monitoring in Europe”, is held in Rovaniemi, Finland November 30th, 2010. Dr. John Derome (1947–2010) had over a forty-year career as a research scientist in the Finnish Forest Research Institute. His research area covered a wide range of forest soil science, including studies on the soil effects of prescribed burning, fertilization, liming and air pollutants. He was also a dedicated member of the international ICP Forests monitoring community. The aim of the seminar is to put forward an outline of the scientific work in which John Derome was involved during his career and to discuss the continuity of his work. The program is divided into three sessions, which will cover the main topics of his studies in Finland (I) and in the Kola Peninsula area (II) and the last session is dedicated to his strong contribution to the ICP Forests monitoring programme (III). The speakers of the seminar were invited in advance and the abstracts of their presentations (10) are included in the abstract book as well as most of the poster session abstracts (15).			
Keywords			
Forest ecosystem, monitoring, nutrients, air pollutants, UN-ECE ICP Forests, EU Life+ FutMon			
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Dear colleagues and friends,

We wish you warmly welcome to the memorial seminar of John Derome (1947-2010). The seminar will put forward an outline of the scientific work in which John Derome was involved during his career. The program is divided into three sessions, which will cover the main topics of his studies in Finland and in the Kola Peninsula area; the last session is dedicated to his strong contribution to ICP Forests monitoring programme.

We wish you an enjoyable stay in Rovaniemi, John's home town for his last 18 years. Our venue, the Sky hotel is located on the top of the Ounasvaara hill. Despite the short period of day light currently prevailing at the Arctic circle, you hopefully will be able to find a moment to enjoy the great view to the town of Rovaniemi and to surrounding nature.

We would like to take the opportunity to thank the invited speakers of the seminar and the session chairmen. We also acknowledge Metla's personnel who helped organizing this seminar, especially Riitta Maunuvaara, Saara Tenhunen, Maija Heino, Anne Siika and Anna-Kaisu Korhonen.

Finally, we hope the seminar will be blessed with a warm spirit which always came along with John's personal charisma.

In November, 2010

Liisa Ukonmaanaho, Kirsti Derome, Pasi Rautio and Päivi Merilä

John "Joonas" Derome

1947–2010

Contents

Metsäntutkijan tie kulki Liverpoolista Suomen Lappiin

Dosentti John Richard Martin Derome kuoli vaikeaan sairauteen 7. kesäkuuta Rovaniemellä. Hän oli 62-vuotias, syntynyt 12. heinäkuuta 1947 Liverpoolissa Englannissa.

John "Joonas" Derome tutustui kesäiseen Suomeen matkaillessaan täällä 1960-luvun lopulla. Suoritettuaan englantilaisen luonnontieteiden kandidaatin tutkinnon biokemiassa hän siirtyi opiskelemaan metsätieteitä Helsingin yliopistoon, josta valmistui vuonna 1975. Jo ennen valmistumistaan, vuonna 1969, John aloitti laboratorioapulaisena ansiokkaan työuransa Metsäntutkimuslaitoksella. Laitoksen silloisen maantutkimusosaston tutkijaksi hän tuli vuonna 1972 ja erikoistutkijaksi vuonna 2000. Maatalous-metsätieteiden tohtoriksi hän väitteli vuonna 2000. Hän toimi myös metsämaatieteen dosenttina Joensuun yliopistossa.

Koko uransa ajan John omistautui metsämaan tutkimukselle. Hänen keskeisimpiä tutkimusaiheitaan olivat metsien kulotus, lannoitus, kalkitus sekä metsämaan ravinnetalous ja ilmansaasteiden maaperävaikutukset. Väitöskirjassaan hän tutki rikki- ja raskasmetallilaskeuman vaikutuksia metsämaahan ja kehitti menetelmiä saastelaskeuman aiheuttamien haittojen lieventämiseksi.

Vuosien myötä Johnista kehittyi eräs kansainvälisimmistä metsäntutkijoistamme ja hänet tunnettiin muun muassa YK:n ja EU:n metsien terveydentilan seurantaohjelman kantavana voimana. Senioritutkijana leijonanosan Johnin ajasta vei Suomen edustaminen useissa kansainvälisissä hankkeissa ja työryhmissä. Tästä huolimatta hän säilytti täysverisen tiedemiehen luonteensa.

John oli kadehdittavan kekseliäs ja käytännöllinen, ja kehitti tarvittaessa menetelmiä sekä laboratorio- että maastokäyttöön. Näiden taitojensa vuoksi hän oli usein kysytty asiantuntija esimerkiksi Venäjällä, jonne John auttoi rakentamaan YK:n metsien seurannan näytealaverkostoa. Venäjä tuli Johnille tutuksi myös useiden jo 1980-luvulla alkaneiden ympäristöntutkimusprojektien myötä. Nämä lähinnä Barentsin alueelle keskittyneet yhteistyöprojektit venäläisten ja norjalaisten ympäristöntutkijoiden kanssa veivät Johnia milloin näytteiden hakuun Kuolan niemimaalle, milloin luennoimaan Siperiaan. Johnin yhteistyö venäläisten kanssa ei rajoittunut pelkästään tieteeseen, sillä John toimi aivan viime päiviinsä saakka myös venäläiskollegoidensa tuottamien englanninkielisten tekstien kielentarkastajana.

Johnin kaksikielisyydestä hyödyimme paljon myös me työtoverit. Hän teki runsaasti käännöstöitä ja tarkasti satojen kollegoidensa englanninkielisiksi tarkoittamien artikkelien, raporttien ja opinnäytetöiden käsikirjoitukset vaivojaan säästämättä. Kielentarkastuksen ohella hän tutkijan pätevyydellään antoi asiantuntevat, mutta aina hienotunteiset kommenttinsa myös käsikirjoitusten asiasisältöön.

John oli henkilö, joka pystyi sopeutumaan mihin maahan ja kulttuuriin tahansa. Suomessakin hän asui Helsingissä, Vantaalla ja viimeiset 18 vuotta Rovaniemellä. Vaikka hän olikin maailmankansalainen, ylpeä liverpoolilaisesta syntyperästään ja irlantilaisesta verenperimästään, niin vain Suomessa hän oli kotonaan. Täällä olivat hänelle kaikkein tärkeimmät: vaimonsa Kirsti, lapset ja Johnin silmäterät, lapsenlapset.

John oli armoitettu hengenluoja ja poikkeuksellisen tunnettu ja pidetty työtoveri niin koti- kuin ulkomaistenkin kollegoiden keskuudessa. Ulkomaisissa kongresseissa hänen yleissivistyksensä muun muassa englanninkielisten sanojen alkuperästä ei milloinkaan lakannut hämmästyttämästä hänen kollegoitaan.

Me kotimaiset kollegat jäämme puolestaan kaipaamaan hänen järjestämiään koti-iltoja, joissa tutuiksi tulivat niin kiinalainen, intialainen kuin englantilainenkin keittiö. Jotkut meistä saivat nauttia hänen vieraanvaraisuudestaan aina Brittein saaria myöten Johnin vanhemmiltaan perimällä Walesin mökillä. Viimeisin näistä "poikien terapiareissuista" järjestettiin, Islannin tuhkapilven sekoittaessa matkasuunnitelmia, vain noin kuukausi ennen hänen kuolemaansa.

Me kollegat jäämme kaipaamaan Johnin lämmintä huumoria, hänen auttavaisuuttaan ja hänen aitoa kiinnostustaan toista ihmistä kohtaan, jotka tekivät hänestä ainutlaatuisen ja unohtumattoman. Johnin poismenon myötä olemme menettäneet korvaamattoman ystävän ja kollegan.

Työtoverit Metlassa

Forest researcher's road from Liverpool to Finnish Lapland

Docent, D.Sc. (For.) John Richard Martin Derome passed away due to a difficult illness on the 7th of June in Rovaniemi. He was 62 years old, born on 12th of July 1947 in Liverpool, England.

John "Joonas" Derome first got to know Finland after visiting the country during a summer in the late sixties. After finishing his B.Sc. studies in biochemistry at the University of Birmingham, he began to study forestry in Helsinki University, from where he graduated in 1975. Even before his graduation, in 1969, John began his commendable career in the Finnish Forest Research Institute as a laboratory technician. In 1972, he was promoted to a researcher and to a senior researcher in 2000. He finished his dissertation in 2000 and got his doctors degree in agriculture and forestry. He also worked as a docent of forest soil science in Joensuu University.

Throughout his career, John Derome dedicated himself to forest soil research. His principal research themes were prescribed burning, fertilizing and liming of forests, soil nutrient budget and the effects of air pollutants on soil. In his dissertation, he studied the effects of sulphur and heavy metal deposition on forest soil and developed methods to reduce the adverse effects of the toxic deposition. During the years John evolved into one of our most international forest researchers and he was known among other things as one of the driving forces in UN-ECE ICP Forests monitoring programme. Although majority of his time as a senior researcher was consumed as a representative of Finland in several international projects and teams, he still kept his nature as a true scientist. John Derome was enviably innovative and practical in developing methods for both laboratory and fieldwork. Because of these traits, John was a very sought after specialist, for example in Russia where he helped to set up the ICP Forests intensive monitoring network. Especially Northern Russia became very familiar to John through many environmental projects beginning already in the 1980's. This Barents area collaboration with Russian and Norwegian environmental researchers took John from sampling in Kola Peninsula to lecturing in Siberia. John's collaboration with the Russian scientists was not limited to just science, until his very last days, he also checked the English language in articles produced by his Russian colleagues.

John's bilingualism was something that all of us colleagues benefitted from. He did plenty of translations and revised hundreds of articles, reports and theses - all supposedly written in English by us Finnish colleagues. Besides revising the language, through his competence as a researcher, he also gave comments on the contents, always with utmost discretion.

John was a person who could adapt into any given country or culture. In Finland, he lived in Helsinki, Vantaa and for the last 18 years, in Rovaniemi. Although he was a cosmopolitan, proud of his Liverpudlian origins and Irish roots, it was in Finland that he felt at home. Here were his dearests, his wife Kirsti, children and most precious of all, grandchildren.

John was a god given entertainer and an exceptionally well-known and liked colleague amongst colleagues. We Finnish colleagues will miss his dinner parties in which English, Indian and other cuisines became familiar. Some of us lucky ones even got to enjoy his hospitality in the British Isles, in the cottage in Wales which John had inherited. The last of these "therapy trip for boys" was organized only a month before his death. We colleagues will miss his warm sense of humour, his helpfulness and his genuine interest in another person. All attributes that made him unique and unforgettable. With John's passing, we have lost an irreplaceable friend and colleague.

John Derome's friends and colleagues in the Finnish Forest Research Institute

Translated by James Derome and Kirsti Derome from the original Finnish text.

John Derome - Ambassador for forest monitoring in Europe

Memorial seminar November 30th, 2010, Rovaniemi, Finland

Seminar programme

08.00-	Registration opens
09.30-10.00	Coffee
10.00-10.15	Welcoming, *Päivi Merilä*, Finnish Forest Research Institute (Metla)

Session I – Domestic cooperation,
chaired by Hannu Ilvesniemi, Metla

10.15-10.45	Intensive monitoring of forest ecosystems in Finland - A review of the results of the scientific studies and monitoring activities, *Antti-Jussi Lindroos*, Metla
10.45-11.15	Research on ecosystem function and restoration of heavy-metal polluted forests, *Heljä-Sisko Helmisaari*, University of Helsinki
11.15-11.45	Litter decomposition rates in relation to carbon quality and stocks in organic horizons in Boreal forest soils, *Sari Stark*, Metla
11.45-13.00	Lunch

Session II – Finnish-Norwegian-Russian cooperation,
chaired by Andy Moffat, Forestry commission, UK

13.00-13.30	20-year Finland - Russia - Norway Cross-Border Cooperation about forest ecosystems: the Russian view, *Natalia Lukina*, Centre for forest ecology and productivity (RAS)
13.30-14.00	Forest ecosystem monitoring in the Pasvik River valley and adjoining areas *Dan Aamlid*, Norwegian Forest and Landscape Institute
14.00-14.30	Effects of the Russian metallurgical industry on the environment in the Finnish-Norwegian-Russian border area, *Jussi Paatero*, Finnish Meteorological Institute
14.30-15.00	Coffee break

Session III – ICP-Forests/FutMon/Forest Focus cooperation,
chaired by Dan Aamlid, Norwegian Forest and Landscape Institute

15.00-15.30	Achievements and challenges of the joint European Forest Condition monitoring under ICP Forests and EU, *Richard Fischer*, Johann Heinrich von Thünen-Institut (vTi)
15.30-16.00	Soil and soil solution research: separate tracks leading to an integrated approach within ICP-Forests, *Bruno de Vos,* Research Institute for Nature and Forest (INBO)
16.00-16.30	Concentrations and fluxes of DOC and DON at Level II sites in Norway and Finland: a comparison, *Nicholas Clarke*, Norwegian Forest and Landscape Institute
16.30-17.00	The value of forest monitoring in developing forest ecosystem science in Britain, *Andy Moffat*, Forestry Commission, UK
17.00-17.10	Closing the seminar, *Liisa Ukonmaanaho*, Metla
17.10-19.30	Poster session
20.00-	Banquet dinner

Session I
Domestic cooperation

John Derome giving instructions to field staff on the Juupajoki Level II plot.

Intensive monitoring of forest ecosystems in Finland – A review of the results of the scientific studies and monitoring activities

Antti-Jussi Lindroos[1], Egbert Beuker[3], Kirsti Derome[2], Martti Lindgren[1], Kaisa Mustajärvi[4], Tiina M. Nieminen[1], Pekka Nöjd[1], Pasi Rautio[2], Maija Salemaa[1], Liisa Ukonmaanaho[1] and Päivi Merilä[4]

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This paper presents some results of the Finnish plots of the European long-term forest monitoring network (EU/UNECE ICP Forests, Level II). We mainly focus on the soil, soil solution and deposition parameters and processes, and their relationships to the overall condition of the forest ecosystems in terms of the nutrient status of the trees and tree defoliation. The SO_4-S deposition on the forests and forest floor has clearly decreased since the beginning of the monitoring activities in 1995 (Lindroos et al. 2006). There has also been a decreasing trend of N deposition on many of the plots located in Southern Finland (Mustajärvi et al. 2008), although the decrease has not been as strong as for sulphur. Foliar sulphur concentrations have shown a slightly decreasing trend in accordance with the observed decrease in S deposition (Merilä 2007). On the other hand, no clear decrease has been found in crown defoliation of the trees on the plots, although there has been a clear decrease in deposition of e.g. sulphur (Lindroos et al. 2006). Defoliation of the spruce stands was found to be correlated with stand age and some of the organic layer chemical properties (Derome et al. 2001). Despite the decreasing input of acidic deposition, no clear changes have generally been found in the soil solution acidity or aluminium concentrations (e.g. Derome et al. 2007), whereas a close relation was detected between soil acidity parameters and climatic factors and podsolization processes (Derome et al. 2001). An interesting exception to the general picture has been a Norway spruce monitoring plot located on acid sulphate soil on the western coast of Finland. The forest soil on this plot is strongly acidified, and this is reflected in extremely high concentrations of heavy metals and aluminium in the soil and soil solution (Lindroos et al. 2007). An important outcome of the soil solution monitoring and studies has also been the testing and implementing of the aluminium fractionation procedure for monitoring purposes carried out by the Finnish Forest Research Institute (Derome et al. 1998). The input and output fluxes of dissolved organic carbon (DOC) in stand throughfall and percolation water and their trends have been studied intensively in relation to climatic conditions in Finland, and no increasing trends, in general, have been detected (Lindroos et al. 2008). The importance of dissolved organic nitrogen (DON) in N cycling has been demonstrated, since e.g. in the leaching fluxes of the forest soils, the DON accounted for 80% of the total N (Mustajärvi et al. 2008). Moreover, the N concentration in spruce needles showed a significant covariation with DON, suggesting that the DON concentration in percolation water may serve as an indicator of N availability in spruce stands (Merilä and Derome 2008).

Finnish ICP-Forest group.

References

Derome, J., Lindroos, A.-J. & Derome, K. 2007. Soil percolation water quality during 2001-2004 on 11 Level II plots. Working Papers of the Finnish Forest Research Institute 45: 93-98.

Derome, J., Lindroos, A.-J. & Lindgren, M. 2001. Soil acidity parameters and defoliation degree in six Norway spruce stands in Finland. Water, Air, and Soil Pollution: Focus 1: 169-186.

Derome, K., Derome, J. & Lindroos, A.-J. 1998. Techniques for preserving and determining aluminium fractions in soil solution from podzolic forest soils. Chemosphere 36: 1143-1148.

Lindroos, A.-J., Derome, J., Raitio, H. & Rautio, P. 2007. Heavy metal concentrations in soil solution, soil and needles in a Norway spruce stand on an acid sulphate forest soil. Water, Air, and Soil Pollution 180: 155-170

Lindroos, A.-J., Derome, J., Derome, K. & Lindgren, M. 2006. Trends in sulphate deposition on the forests and forest floor and defoliation degree in 16 intensively studied forest stands in Finland during 1996-2003. Boreal Environment Research 11: 451-462.

Lindroos, A.-J., Derome, J., Mustajärvi, K., Nöjd, P., Beuker, E. & Helmisaari, H.-S. 2008. Fluxes of dissolved organic carbon in stand throughfall and percolation water in 12 boreal coniferous stands on mineral soils in Finland. Boreal Environment Research 13, Suppl.B: 22-34.

Merilä, P. 2007. Needle chemistry on the intensive monitoring plots 1995-2003. Working Papers of the Finnish Forest Research Institute 45: 46-62.

Merilä, P. & Derome, J. 2008. Relationships between needle nutrient composition in Scots pine and Norway spruce stands and the respective concentrations in the organic layer and in percolation water. Boreal Environment Research 13, Suppl.B: 35-47.

Mustajärvi, K., Merilä, P., Derome, J., Lindroos, A.-J., Helmisaari, H.-S., Nöjd, P. & Ukonmaanaho, L. 2008. Fluxes of dissolved organic and inorganic nitrogen in relation to stand characteristics and latitude in Scots pine and Norway spruce stands in Finland. Boreal Environment Research 13, Suppl.B: 3-21.

Research on ecosystem function and restoration of heavy-metal polluted forests

Heljä-Sisko Helmisaari[1], Maija Salemaa[2], Oili Kiikkilä[2], Christian Uhlig[3] and Tiina M. Nieminen[2]

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The Harjavalta area is one of the areas most seriously polluted by heavy metals in Finland (Helmisaari et al. 1995). Copper smelting first started in 1945, and nickel smelting in 1959. The smelted ore concentrates contain sulphur, trace metals and arsenic. Due to the relatively low stacks during the 1940´s–1980´s when the emissions were very high, most of the emitted Cu and Ni was deposited close to the smelter (< 2 km).

Finnish Forest Research Institute established an ecosystem study in the surroundings of Harjavalta in 1991. Four study sites were established in Scots pine stands at distances of 0.5, 2, 4 and 8 km to the SE of the Cu-Ni smelter. Due to the long-term accumulation of Cu and Ni in the soil, a steep concentration gradient was visible in the soil and vegetation. The pine stand at 0.5 km was severely damaged by heavy metals, but the stands at 4 and 8 km were relatively unaffected. The ecosystem study was carried out on the control plots of the experiments using compensatory fertilisation for detoxification and amelioration of heavy-metal contaminated forest soils by means of liming and fertilisation.

Although emissions of SO_2 and heavy metals from the smelters were gradually reduced especially in the 1990´s, the topsoil of neighbouring forested sites still contained 50 years' accumulation of a wide range of heavy metals (Derome and Lindroos 1998a,b). Microbial activity and litter mineralization were strongly retarded (Kiikkilä 2002a), the Scots pine trees were suffering from serious defoliation, disturbed nutrient status and growth retardation (Nieminen et al. 1999, 2004), and fine root mortality was high. The understorey vegetation was almost completely degraded (Salemaa et al. 2001, 2004; Uhlig et al. 2001). This enhanced the wind erosion of metal-contaminated particles, decreased the water-holding capacity of the soil and may have facilitated the leaching of heavy metals (Derome and Nieminen 1998, Kiikkilä 2002a) into the groundwater. Also the thick undecomposed litter layer, shortage of nutrients (Derome and Lindroos 1998a,b) and extremely dry conditions made natural revegetation difficult.

Emission reduction had a direct positive effect on air quality and deposition near smelters but a minimal effect on the amount of heavy metals accumulated in the forest soil for decades. The compensatory fertilisation, especially liming, reduced the soil concentrations of heavy metals (Derome 1999, 2000), and improved the condition and growth of the tree stand (Mälkönen et al. 1999), but did not help in revegetation of the most polluted site. The conclusion was that without soil restoration measures, the accumulated heavy metals continue to affect the vegetation for a very long period.

Based on the conclusions of the ecosystem and fertilisation studies, a remediation experiment was established in 1996 on the most polluted site. The aim was to promote long-term recovery of a heavy-metal polluted forest ecosystem through the establishment of a functioning organic layer, and through revegetation using seedlings of native trees and dwarf shrubs.

Despite initial mortality, transplant establishment was successful. Spreading a mulch layer on the soil surface was essential for the survival of the tree seedlings and dwarf shrubs, especially, partly through protection against drought. In particular, *Empetrum nigrum* and *Pinus sylvestris* proved to be suitable for revegetating the degraded forests. Natural recolonization of pioneer species and tree seedlings was strongly enhanced on the mulched plots, whereas there was no natural vegetation on the untreated plots. The long-term results indicate that a heavy-metal polluted site can be ecologically remediated without having to remove the soil. Organic compost and woodchips is a low-cost mulching material that is suitable for restoring heavy-metal polluted soil (Helmisaari et al. 2007; Kiikkilä et al. 2001, 2002b). The remediated 5x5m plots are now green patches in the barren environment.

References

Derome, J. 1999. Detoxification and amelioration of heavy-metal contaminated forest soils by means of liming and fertilisation. Environmental Pollution 107(1):79-88.

Derome, J. 2000. Effects of heavy-metal and sulphur deposition on the chemical properties of forest soil in the vicinity of a Cu-Ni smelter, and means of reducing the detrimental effects of heavy metals.The Finnish Forest Research Institute, Research Papers 769. 78 p.

Derome, J. & Lindroos, A.-J. 1998a. Effects of heavy metal contamination on macronutrient availability and acidification parameters in forest soil in the vicinity of the Harjavalta Cu-Ni smelter, SW Finland. Environmental Pollution 99(2):225-232.

Derome, J. & Lindroos, A.-J. 1998b. Copper and nickel mobility in podzolic forest soils subjected to heavy metal and sulphur deposition in western Finland. Chemosphere 36(4/5):1131-1136.

Derome, J. & Nieminen, T. 1998. Metal and macronutrient fluxes in heavy-metal polluted Scots pine ecosystems in SW Finland. Environmental Pollution 103:219-228.

Derome, J., Nieminen, T. & Saarsalmi, A. 2004. Sulphur dioxide adsorption in Scots pine canopies exposed to high ammonia emissions near a CU-NI smelter in SW Finland. Environmental Pollution 129(1):79-88.

Helmisaari, H.-S., Derome, J., Fritze, H., Nieminen, T., Palmgren, K., Salemaa, M. & Vanha-Majamaa, I. 1995. Copper in Scots pine forests around a heavy-metal smelter in south-western Finland. Water, Air, and Soil Pollution 85(3):1727-1732.

Helmisaari, H.-S., Salemaa, M., Derome, J., Kiikkilä, O., Uhlig, C. & Nieminen, T. 2007. Remediation of heavy metal-contaminated forest soil using recycled organic matter and native woody plants. Journal of Environmental Quality 36:1145-1153.

Kiikkilä, O., Derome, J., Brügger, T., Uhlig, C. & Fritze, H. 2002a. Copper mobility and toxicity of soil percolation water to bacteria in a metal polluted forest soil. Plant and Soil 238:273-280.

Kiikkilä, O., Pennanen, T., Perkiömäki, J., Derome, J. & Fritze, H. 2002b. Organic material as a copper immobilising agent: a microcosm study on bioremediation. Basic and Applied Ecology 3(3):245-253.

Kiikkilä, O., Perkiömäki, J., Barnette, M., Derome, J., Pennanen, T., Tulisalo, E. & Fritze, H. 2001. In situ bioremediation through mulching of soil polluted by a copper-nickel smelter. Journal of Environmental Quality 30:1134-1143.

Mälkönen, E., Derome, J., Fritze, H., Helmisaari, H.-S., Kukkola, M., Kytö, M., Saarsalmi, A. & Salemaa, M. 1999. Compensatory fertilization of Scots pine stands polluted by heavy metals. Nutrient Cycling in Agroecosystems 55:239-268.

Nieminen, T.M., Derome, J. & Helmisaari, H.-S. 1999. Interactions between precipitation and Scots pine canopies along a heavy-metal pollution gradient. Environmental Pollution 106:129-137.

Nieminen, T.M., Derome, J. & Saarsalmi, A. 2004. The applicability of needle chemistry for diagnosing heavy metal toxicity to trees. Water, Air, and Soil Pollution 157:269-279.

Salemaa, M., Derome. J. Helmisaari, H.-S., Nieminen, T. & Vanha-Majamaa, I. 2004. Element accumulation in boreal bryophytes, lichens and vascular plants exposed to heavy metal and sulfur deposition in Finland. The Science of the Total Environment 324:141-160.

Salemaa, M., Vanha-Majamaa, I. & Derome, J. 2001. Understorey vegetation along a heavy-metal pollution gradient in SW Finland. Environmental Pollution 112(3):339-350.

Uhlig, C., Salemaa, M., Vanha-Majamaa, I. & Derome, J. 2001. Element distribution in Empetrum nigrum microsites at heavy metal contaminated sites in Harjavalta, western Finland. Environmental Pollution 112(3):435-442.

Litter decomposition rates in relation to carbon quality and stocks in organic horizons in boreal forest soils

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Introduction

There is an increasing need for understanding the factors that regulate the soil carbon stocks in boreal forest ecosystems. Climate directly affects the litter decomposition through temperature and moisture, but climate can also have an indirect effect on litter chemistry through influence on plant-community composition and litter quality. We investigated how chemical quality of fresh litter and its decomposition rate vary between the north and south boreal forests, and between the sub-xeric and mesic site types. By comparing the chemical quality and quantity among the litter types and the soil layers in the organic horizon, we also investigated to which extent different growth forms in boreal forests (trees, dwarf shrubs and mosses) contribute to the humus formation in different vegetation zones and site types.

Material and methods

In connection with Forest Focus Programme, an intensive study on the litter and soil carbon quality and quantity, linked with the rates of decomposition, was conducted in 12 of the sites used for forest monitoring. In 2002 and 2003, intact plant-soil -samples were collected in the field and carefully sorted by the layers in the organic horizon (litter layer L, fermentation layer F, humus layer H). Litter was sorted by species. In 2005, a long-term litter decomposition experiment was initiated with measuring decomposition rates of the needle litter, bilberry leaves, and moss litter. All samples were chemically characterized using sequential fractionation (Ryan et al. 1990). Also the main parameters, such as C/N ratio, concentration of soluble phenolics, concentration of soluble sugars, and exchangeable nutrients were also analyzed.

Results and discussion

There was no difference in the chemistry of freshly fallen litter, or the decomposition rate of needle, bilberry and moss litter, between the north and the south boreal forests (Hilli et al. 2010). However, there were great differences in the decomposition rates among the litter types. Analyses of the soil carbon stocks showed clear differences between the south and the north boreal forests. In the south, tree litter constitutes much more important litter carbon stock than in the north, where understorey vegetation and mosses have a more important role (Hilli et al. 2010). Also the chemical composition of the humus layer differed: the concentration of slowly-decomposable carbon was higher in the south than north boreal forests, whereas the concentration of soluble sugars and phenolics were higher in the north (Hilli et al. 2008a,b). The results of this project demonstrate that the difference in the ground vegetation, and hence, the production of various litter types (trees, understorey higher plants, mosses) between the north and the south boreal forests seems much more important in determining the soil carbon stocks than the difference in the rate of decomposition.

References

Ryan, M.G., Melillo, J. & Ricca, A., 1990. A comparison of methods for determining proximate carbon fractions of forest litter. Canadian Journal of Forest Research 20, 166–171.

Hilli, S., Stark, S. & Derome, J. 2008a. Carbon quality and stocks in organic horizons in boreal forest soils. Ecosystems 11, 270–282.

Hilli, S., Stark, S. & Derome, J. 2008b. Qualitative and quantitative changes in water-extractable organic compounds in the organic horizon of boreal coniferous forests Boreal Environment Research 13, (suppl. B), 107-119.

Hilli, S., Stark, S. & Derome, J. 2010. Litter decomposition rates in relation to litter stocks in boreal conferous forests along climatic and soil fertility gradients. Applied Soil Ecology, in press.

Session II
Finnish-Norwegian-Russian cooperation

John Derome with his Russian colleague Natalia Lukina.

20-year Finland-Russia-Norway cross-border co-operation activities related to forest ecosystems: the Russian view

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The Finnish-Russian-Norwegian cross-border co-operation related to monitoring and study of anthropogenic effects on terrestrial ecosystems has been started in 1990. This cooperation contributed greatly to raising the Iron Curtain. The cooperative efforts were aimed at the development of monitoring network and improvement of knowledge. The studies were carried out in the framework of different projects: the Finnish Lapland Forest Damage Project (Tikkanen and Niemela 1995), the Skogforsk-NINA-VNIIPRIRODA-IGCE project (Aamlid et al. 2000), the NINA-NGU-INEP-METLA project (Yoccoz et al. 2001), Project Ka 00 72 Interreg III Kolarctic, 2003-2006 (Derome et al. 2007) and others. Since 2007 cooperation between Finland and Russia continued in the framework of ICP Forests. John Derome, our great friend, was the heart of our cooperation.

The results of cooperative works have shown that the non-ferrous metal smelters located in Russia are responsible for the direct and indirect effects on plants and soils in the border area. The effects include elevated pollutant concentrations in soil and plant tissues, changes in nutrient availability and nutrient uptake by plants, visible leaf damage, a decrease in the number of needle age classes in conifers, the reduced lichen vegetation on stems and on the forest floor, and the reduced or absent moss vegetation in the area and etc. It is difficult to differentiate the direct effects of heavy metals from those caused by the high SO_2 concentrations emitted by smelters. The lack of widespread soil acidification, despite the high SO_2 emissions, have been attributed to the abundant occurrence of basic types of bedrock and to the relatively low rate of conversion of SO_2 to sulphuric acid in the relatively dry, cold Arctic climate (Derome et al. 2007). Non-linear changes in the acidity of the organic horizons in relation to the deposition of acidifying substances have been explained by variations in the formation of natural organic acids in forest soil related to the amount of litterfall. In recent years a decrease in the emissions of SO_2 has been observed, but that this has not been followed by a corresponding decrease in heavy metal emissions. There are signs of a slight recovery of terrestrial ecosystems in the area around the emission source, but the concentrations of plant available heavy metals are still very high (Derome et al. 2007).

Some approaches to rehabilitation of lands subjected to air pollution have been elaborated.

References

Aamlid, D., Vassilieva, N., Aarrestad, P.A., Gytarsky, M., Lindmo, S., Karaban, R., Korotkov, V.,Rindal, T., Kusmicheva, V. & Venn, K. 2000. Ecosystem monitoring in the border areas between Norway and Russia. Boreal and Environmental Research 5: 257- 278.

Derome, J., Aarrestad, PA., Aspholm, P., Bakkestuen, V., Bjerke, J.,Erikstad, K., Gytarsky, M., Hartikainen, M., Isaeva, L., Karaban, R.,Korotkov, V., Kuzmicheva, V., Lindgren, M., Lindroos, AJ., Myking, T.,Poikolainen, J., Rautio, P., Røsberg, I., Salemaa, M., Tömmervik, H. & Vassilieva, N. Current state of terrestrial ecosystems inthe joint Norwegian, Russian and Finnish border areaProject Ka 00 72 Interreg III Kolarctic/ Final report Development and implementation of an environmental monitoring and assessment programme in the joint Finnish, Norwegian and Russianborder area, 2003 - 2006

Tikkanen, E. & Irja Niemela, I. (eds.) 1995. Kola Peninsula pollutants and forest ecosystems in Lapland :final report of the Lapland Forest Damage Project [Helsinki] :Finland's Ministry of Agriculture and Forestry, Finnish Forest Research Institute.

Yoccoz, N.G., Tømmervik, H., Bakkestuen, V., Nikonov V., N. Lukina, N., Jensen, H., Finne,T.R., & Henttonen, H. 2001. Environmental and Pollution Impact Research and Competence BuildUp in Northern Norway Through Integrated Ecological, Geological and Remote Sensing Studies. A Multidisciplinary Project between NINA, NGU, INEP and METLA. Final Project Report. pp. 122.

Forest ecosystem monitoring in the Pasvik River valley and adjoining area

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Introduction

The Pasvik River valley is the easternmost part of Norway, and borders to Finland and Russia. In Norway it is known for its wilderness and taiga forests. During the 1960–1970s most of the mature pine forests were harvested, and large areas of pine stands have been naturally regenerated. In addition, large areas are covered with birch. The Pasvik River valley and the adjoining areas are therefore important both as an area for growing timber resources and for recreation. However, these areas have also been exposed to air pollution from Russian smelting industry since the 1930s. In addition to sulphur dioxide, emissions consist of various heavy metals which contaminate the surroundings. The main pollution source is the huge nickel plant in the Russian city Nikel, located only 10 km from the Norwegian border. For a long time there was general concern for the quality of the forest ecosystems in these areas. This concern accelerated in the mid-1980s.

A pilot study was therefore executed in 1987. This was the start of our forest monitoring in the Pasvik area. This first initiative mainly focused on visible symptoms of sulphur dioxide and chemical analyses of birch leaves. In 1988 the first systematic survey of crown condition, leaf and moss chemistry was carried out on observation plots located in a 4 x 4 km grid, based on the methods used in the newly started European ICP Forests programme. However, these methods were then not fully developed, e.g. methods for lichen and ground vegetation assessment. Suitable methods had therefore to be developed (Aamlid and Venn 1993). During the development and data treatment/analyses discussions with colleagues in the ICP Forests programme and Nordic forums (SNS ad hoc group on forest damage) were very important.

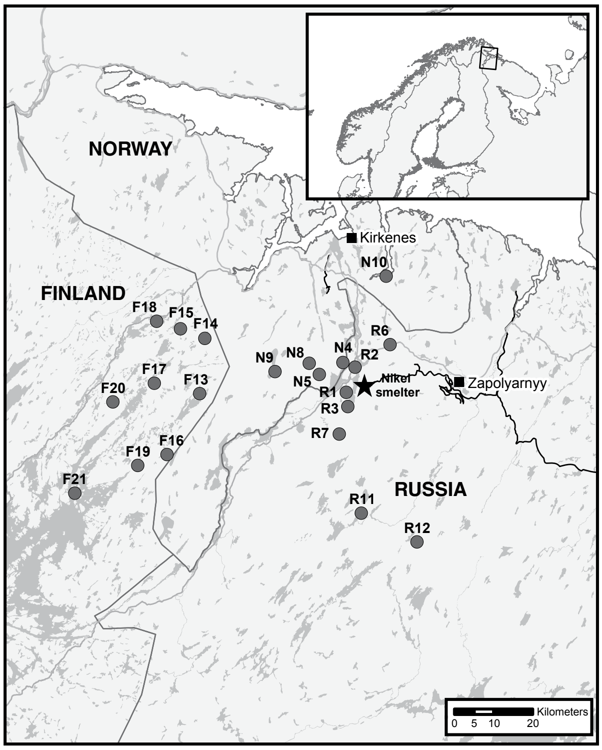

Figure 1. Several plots for intensive monitoring have been established in the area. The figure shows the network used in the INTERREG programme (From Myking et al. 2009).

In 1993 four sites for intensive monitoring were established. Additional plots were established in 1995 through Norwegian-Russian cooperation (the Skogforsk-NINA-VNIIPRIRODA-IGCE monitoring plots), and through the INTERREG programme (Norway, Finland and Russia) in 2004.

Main findings

Air pollution impacts to the area were shown in many of the investigations. The effect on tree crowns was visibly expressed by needle tip yellowing and foliar injury typical for plant tissue exposed to high concentrations of sulphur dioxide. Such observations were common in the years 1985–1991. Symptoms were also found on ground vegetation species (Aamlid 1993). Impact on general crown condition (crown thinning) has hardly been observed in any of the surveys performed, except from dying trees just outside the industrial areas in the vicinity of Nikel.

Epiphytic lichens are well known as organisms sensitive to air pollution, and the epiphytic lichen coverage on birch stems has been studied in all the investigations. Aamlid and Skogheim (2001) investigated birch stems at the plots located in the 4x4 km grid. *Hypogymnia physodes* and *Melanelia olivacea* were the two most abundant lichen species. The results clearly showed that the lichen vegetation increased with increasing distance from the pollution source, i.e. from a 'lichen desert' to normal background levels. This coincided with concentrations of sulphur dioxide measured and modelled by the Norwegian Institute for Air Research (NILU). Similar observations were reported by the INTERREG project (INTERREG IIIA Kolarctic), which investigated the epiphytic lichen cover on trunks of downy birch and Scots pine on their 21 plots (Myking et al. 2009).

Elevated concentrations of elements such as nickel (Ni) and copper (Cu) in plant tissue (needles, leaves, grasses and mosses) showed more or less the same pattern (Koptsik et al. 2001). In a study of heavy metal contents in cloudberries and bilberries from 1992 (Aamlid and Skogheim 1993), elevated concentrations of copper, nickel, and to some extent arsenic were reported in areas closest to the smelter in Nikel. A similar pattern was later confirmed by Myking (2009), with, however, lower concentrations. The differences might be due to different chemical methods used.

Assessment of ground vegetation (vascular plants, bryophytes and lichens) revealed that the impact on ground vegetation was most related to negative effects on abundance and richness of epigeic lichens and bryophytes (Aarrestad and Aamlid 1999, Aamlid et al. 2000, Myking et al. 2009).

The results from the projects that have been executed in the area have been of great importance for evaluations of the arctic nature as summarised in the chapter on effects on terrestrial ecosystems in the report from the Arctic Monitoring and Assessment programme, AMAP (Derome et al. 2006).

References

Aamlid, D & Venn, K. 1993. Methods of monitoring the effects of air pollution on forest and vegetation of eastern Finnmark, Norway. Norwegian Journal of Agricultural Sciences 7: 71--87.

Aamlid, D. 1993. Symptoms of sulphur dioxide injuries on some boreal plants. S. 93-102 i: Jalkanen, R., Aalto, T. and Lahti, M.-L. (Eds.) Forest pathological research in Northern forests with special reference to abiotic stress factors. Extended SNS meeting in forest pathology in Lapland, Finland, 3-7 August 1992. Metsäntutkimuslaitoksen tiedonantoja 451.

Aamlid, D. & Skogheim, I. 1993. Nikkel, kopper og andre metaller i multer og blåbær fra Sør-Varanger, 1992. Rapp. Skogforsk, 14/93:1-15.

Aamlid, D., Vassilieva, N., Aarrestad, P.A., Gytarsky, M.L., Lindmo, S., Karaban', R., Korotkov, V., Rindal, T., Kuzmicheva, V., & Venn, K. 2000. The ecological state of the ecosystems in the border areas between Norway and Russia Boreal Env. Res. 5:257-278

Aamlid, D. & Skogheim, I. 2001. Occurrence of *Hypogymnia physodes* and *Melanelia olivacea* lichens on birch stems in north boreal forests influenced by local air pollution. Norsk Geografisk Tidsskrift – Norwegian Journal of Geography 55: 94-98. Oslo).

Aarrestad, P.A. & Aamlid, D. 1999. Vegetation monitoring in South-Varanger, Norway – Species composition of ground vegetation and its relation to environmental variables and pollution impact. Environmental Monitoring and Assessment 58:1-21.

Derome, J., Manninen, S., Aherne, J. Hellstedt,P., Hettelingh J.-P., Hicks,K., Huttunen,S., Kämäri,J., Kashulina,G., Kozlov,M., Markkola,A., Posch,M., Ruotsalainen,A.-L.,Salminen,R. & Zvereva, E. 2006. Effects on terrestrial ecosystems. Chapter 4. In: AMAP Assessment 2006. Acidifying Pollutants, Arctic Haze, and Acidification in the Arctic. Arctic Monitoring and Assessment Programme (AMAP), Oslo, Norway. Xii+112pp.

Koptsik, G. N., Koptsik, S. V. & Aamlid, D. 2001. Pine needle chemistry near a large point SO_2 source in northern Fennoscandia, Europe. Water, Air, and soil Pollution. 130:929-934.

Myking, T., Aarrestad, P.A., Derome, J., Bakkestuen, V., Bjerke, J.W., Gytarsky, M., Isaeva, L., Karaban, R., Korotkov, V., Lindgren, M., Lindroos,A.-J., Røsberg, I., Salemaa, M., Tømmervik, H., & Vassilieva, N., 2009. Effects of air pollution from a nickel-copper industrial complex on boreal forest vegetation in the joint Russian-Norwegian-Finnish border area. Boreal Environment Research 14:279-296.

Myking, T. Content of heavy metals in cloudberries and bilberries in Sør-Varanger, Finnmark 2008. Fylkesmannen i Finnmark, Rapport nr. 3 – 2009: ISSN 0800-2118. [http://www.fylkesmannen.no/tungmetaller_i_multer_mva_rapport_ssrIC.pdf.file]

Effects of the Russian metallurgical industry on the environment in the Finnish-Norwegian-Russian border area

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The metallurgical industry at Kola Peninsula, north-west Russia is the most important source of air pollution in the European sector of the Arctic. The non-ferrous metal smelters in the area emit huge quantities of sulphur, metals and inhalable particles to the atmosphere. These pollutants have a serious impact to the atmosphere and biosphere, even "industrial deserts" at Kola Peninsula. The present sulphur emissions to the atmosphere from the metallurgical industry of the Kola Peninsula are bigger than the whole emissions of Finland. Kostamus (Kostomuksha) iron mine and processing facility is located in the Republic of Karelia, Russian Federation, about 80 km north-east of the town of Kuhmo, Kainuu province, Finland. The recent emissions have been about one third of the total sulphur emissions in Finland. The effects of the air pollution from these sources were studied in three projects in 2002–2007 (Paatero et al. 2006, Paatero et al. 2008, Várkonyi et al. 2008).

In Finland the westerly winds are dominating taking often the emitted air pollutants further away from the Finnish-Russian-Norwegian border area. Yet, during easterly winds the concentrations of sulphur dioxide, aerosol particles and metals in the air can increase radically in the border area. In Finland the pollutant emissions from the Kola smelters seem to have no clear impact on the terrestrial environment, there is no east to west gradients in neither metal contents of berries nor in pine tree condition. The air quality related to heavy metals and aerosol particles in Kainuu province is typical for rural background areas in Finland. The most important source of airborne heavy metals in the area is long-range transport from densely populated and industrialised regions. The process waters released from the industrial plants, however, have effects on e.g. fish populations downstream from the plants.

References

Paatero, J., Makkonen, U., Kauhaniemi, M., Salmi, T., Stebel, K. & Grekelä, I. 2006. Effects of the Pechenganikel smelter to air quality in the Finnish-Norwegian-Russian border area. In: Modern Ecological Problems of the North (To the Centenary of the O.I. Semenov-Tyan-Shansky Birthday). Proceedings of the International Conference 10-12 October 2006, Apatity. Part 2. Russian Academy of Sciences - Kola Science Centre, Apatity, Russia, 2006. p. 223-227.

Paatero, J., Dauvalter, V., Derome, J., Lehto, J., Pasanen, J., Vesala T., Miettinen, J., Makkonen, U., Kyrö, E.-M., Jernström, J., Isaeva, L. & Derome, K. 2008. Effects of Kola air pollution on the environment in the western part of the Kola peninsula and Finnish Lapland - final report. Reports 2008:6. Finnish Meteorological Institute, Helsinki. 26 p.

Várkonyi, G., Heikkilä, R. & Heikkilä, J. (Eds.) 2008. The impact of Kostomuksha mining plant on human environment on the Finnish-Russian border. Reports of Kainuu Regional Environment Centre 2/2008. Kainuu Regional Environment Centre, Kuhmo, Finland. 45 p.

Session III
ICP-Forests/FutMon/Forest Focus cooperation

ICP Forest Task Force Meeting, visiting in a Level II plot in Slovakia in 2007.

Achievements and challenges of the joint European Forest Condition Monitoring under ICP Forests and EU

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The International Co-operative Programme on Assessment and Monitoring of Air Pollution Effects on Forests (ICP Forests) was founded in 1985 under the UNECE Convention on Long-range Transboundary Air Pollution (CLRTAP). John Derome represented the Finnish National Focal Centre of the ICP Forests from 2004 to 2010. From 2006 onwards he chaired the programme's Working Group on Soil Solution.

ICP Forests provides field-based, continuous and harmonized monitoring data on forests for most countries in Europe. Monitoring occurs at two levels of intensity: 'Level I' monitoring involves ~ 6000 systematically selected plots in 38 participating countries across Europe, while the more intensive 'Level II' monitoring takes place on ~ 500 plots in a number of the most important forest ecosystems in 29 participating countries. Close cooperation between the European Commission and ICP Forests since 1986 was followed by the project "Further Development and Implementation of an EU-level Forest Monitoring System" (FutMon).

The programme has contributed scientific results to national and European policies. Ten years time trends of around 150 continuously monitored ICP Forests plots show that mean annual sulphur inputs decreased by 30% between 1998 and 2007. Mean nitrogen inputs showed only a minor decrease. Biological diversity on the monitoring plots is affected by nitrogen deposition. Ground vegetation composition has changed towards more nitrogen tolerant species. Nitrogen deposition was statistically linked to the present species composition and is a driver for ongoing change. Statistical models in addition show relations between nitrogen deposition and forest growth. Forest growth was also significantly related to temperature increase in terms of deviations from long-term temperature means. Carbon models based on a selection of intensive monitoring plots predict an increasing net ecosystem production under current climate change scenarios characterized by rising temperature and atmospheric CO_2 concentrations and decreasing precipitation.

Over the past 25 years, continued commitments of national ministries, research institutes and experts as well as the co-financing by the European Commission were the basis for sustained and harmonized long-term monitoring. The data sets of the programme are unrivalled but the political scene is constantly changing and the demands of the scientific community on the data are increasing. A legal basis for forest monitoring is under debate. Results from the COST FP 0903 action in which John Derome has represented Finland show that in the future, intensified collaboration between different monitoring and research networks will gain increased importance. Finland is an excellent example for such cooperation on the national level.

In this context, and based on his national experience John Derome has certainly been a forward looking ambassador for forest monitoring in Europe, both on the scientific and on the policy level.

Soil and soil solution research: separate tracks leading to an integrated approach within ICP-Forests?

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This presentation reviews the soil surveying and soil solution monitoring carried out within the ICP-Forests programme since 1985. For both approaches, we reflect on their history, current status and future challenges. The contributions of Finnish scientists, particularly those of John Derome are highlighted and acknowledged.

National forest soil survey initiatives, conducted according to a systematic grid (~ level I) formed the initial basis. Sweden and Finland were the first countries to start reporting soil data in 1985 and 1986, respectively. Germany, Austria and Norway joined them in the following years, and 18 other countries conducted their soil surveys in the period 1990-1996. The Forest Soil Coordinating Centre (FSCC) analysed these level I data and published the 1st Forest Soil Condition Report (Vanmechelen et al. 1997) considerably contributing to the knowledge at that time. However, the main problem was the lack of transnational data comparability due to differences in sampling and analysis methods. This initiated a long harmonisation and standardisation process followed-up by consecutive Forest Soil Expert Panel meetings (FSEPM) and requiring 4 revisions of the soil manual.

A similar evolution is observed for intensive soil monitoring on permanent observation plots (level II), installed by most countries in the early nineties. Lead countries for analysing soil water chemistry were the Netherlands, Ireland and Germany. Other countries joined from 1995 onwards, guided by the Forest Intensive Monitoring Coordinating Institute (FIMCI). Also soil solution monitoring needed harmonisation. At the 5th FSEPM (1995), a first proposal of “soil liquid phase analysis” was presented by the German delegation and a “Soil water expert group” was raised. In 1998 the first submanual on soil solution sampling and analysis was adopted. At that time, John Derome came into action. In September 2000 he chaired the Soil water meeting in Copenhagen, which evolved into the Working group on Soil Solution (2001, Ispra). Based on a critical review of lysimeter techniques and data intercompatibility (Derome et al. 2001), he elaborated a major revision of the soil solution manual (Derome et al. 2002). In 2008, the Working Group merged with the FSEP to become the Expert Panel on soil and soil solution with John as vice chairman. Further integration of QA/QC in soil-water-plant laboratories under the lead of Nils König, was strongly supported by John & Kirsti Derome and resulted in practical guidelines (Clarke et al. 2008).

During the current Life+ FutMon project (2009–2010) the manuals of all expert panels are restructured and partially integrated. Together with John Derome’s Finnish colleagues we will try to further incorporate his views and ideas into the soil solution chapter.

While the FSCC is elaborating the 2nd Forest Soil Condition Report based on BioSoil data, the PCC is screening and evaluating the soil solution data series of 1990–2006. Both studies will definitely lead to more consistent databases and insights into data potential and limitations. At the end of FutMon, all survey data should reside in a well structured ICP-Forests database.

The future holds promise to further explore the unique soil and soil solution datasets gathered at the pan-European scale. Time is near to interrelate and integrate soil and soil solution data, in a way that they can be linked with other ICP-Forests datasets. Numerous challenges for relating soil information to anthropogenic and natural stress factors, tree condition, climate change, biodiversity and sustainable forest management are just waiting to meet us.

References

Clarke, N., Cools, N., Derome, J., Derome, K., De Vos, B. Fuerst, A., Koenig, N., Kowalska, A., Mosello, R., Tartari, G. A. and E. Ulrich. 2008. Quality Assurance and Control in Laboratories. A review of possible quality checks and other forms of assistance. ICP Forests Working Group on QA/QC in Laboratories. ICP-Forests. 56 pp. Available at: http://www.icp-forests.org/DocsQualLab/QualCheckMay2008.pdf. [Cited 28 Oct 2010].

Derome, J., Bille-Hanssen, J. and Lindroos, A-J. 2001. Evaluation of the lysimeter techniques employed in monitoring soil solution quality in the European level II intensive plot network, and assessment of the future intercompatibility of the soil solution data. Technical report. EU Project 99.60.SF.005.0. Rovaniemi, Finland. 36 pp

Derome, J., and Expert Panel on Soil. 2002. Submanual on soil solution collection and analysis. ICP forest manual part IIIb. International Co-operative Programme (ICP) on Assessment and Monitoring of Air Pollution Effects on Forests. Available at: http://www.icp-forests.org/pdf/manual3b.pdf [Cited 28 Oct 2010]

Vanmechelen, L., R. Groenemans, and E. Van Ranst. 1997. Forest Soil Condition in Europe. Results of a Large-Scale Soil Survey. EC, UN/ECE, ICP Forests and the Ministry of the Flemish Community. 261 p.

Concentrations and fluxes of DOC and DON at Level II sites in Norway and Finland

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Concentrations of dissolved organic carbon (DOC) in throughfall and soil solutions at 5, 15 and 40-cm depth were studied in 16 Norway spruce and two Scots pine plots throughout Norway between 1996 and 2006 (Wu et al. 2010a). Average DOC concentrations ranged from 2.3 to 23.1 mg/l and from 1.1 to 53.5 mg/l in throughfall water and soil solutions, respectively. Concentrations of DOC in throughfall and soil waters varied seasonally at most plots with peaks in the growing season. In contrast to reported positive long-term trends in DOC concentrations in surface waters between 1986 and 2003, soil water data from 1996 to 2006 showed largely negative trends in DOC concentrations and no significant trends in throughfall. However, regression analysis for individual sites, particularly at 5- and 15-cm soil depths, showed that DOC concentrations in soil water were significantly and negatively related to non-marine sulphate and chloride.

Further studies were carried out on dissolved organic nitrogen (DON, Wu et al. 2010b). Dissolved organic nitrogen (DON) concentrations were significantly and positively correlated to DOC concentrations in throughfall (r^2=0.72, $p<0.0001$) and soil water at 5, 15, and 40 cm (r^2=0.86, 0.32, and 0.84 and $p<0.0001$, 0.04, and <0.0001, respectively). At most sites, the annual median DOC/DON ratio in throughfall ranged from 20.3 to 55.5, while values in soil water were higher, ranging from 24.5 to 81.3 but gradually decreasing with soil depth. DON concentrations varied seasonally in throughfall at many plots and in soil water at 5 cm depth at one plot only, with higher values in the growing season, but there was no noticeable seasonality at greater depth. The ratios of DOC/DON in soil water were significantly positively related to the C/N ratio in soil at the same depth. Above-ground litter input was the main factor having a significant, negative relationship to DOC/DON in soil water at all depths studied. This might reflect the effect of site conditions on both DOC/DON ratios and litter quantity.

A comparison of DOC and DON concentrations and fluxes at two Norwegian sites (Birkenes and Hirkjølen) and five Finnish Level II plots (Tammela, Juupajoki, Uusikaarlepyy, Kivalo and Pallasjärvi) showed no obvious correlation between concentrations and site and stand properties such as growing season length, temperature, precipitation, stand age, or soil C or N. DOC concentrations in the O horizon could not be linked to N deposition. However, there were clear within-site seasonal trends, compatible with an effect of temperature on microbial activity.

References

Wu, Y., Clarke, N. & Mulder, J. 2010a. Dissolved Organic Carbon Concentrations in Throughfall and Soil Waters at Level II Monitoring Plots in Norway: Short-term and Long-term Variations. Water Air and Soil Pollution 205(1-4): 273–288.

Wu, Y., Clarke, N. & Mulder, J. 2010b. Dissolved Organic Nitrogen Concentrations and Ratios of Dissolved Organic Carbon to Dissolved Organic Nitrogen in Throughfall and Soil Waters in Norway Spruce and Scots Pine Forest Stands Throughout Norway. Water Air and Soil Pollution 210(1-4): 171-186.

The value of forest monitoring in developing forest ecosystem science in Britain

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For nearly all 20th century, UK forest science evolved largely through experimentation in the laboratory, nursery and in the forest itself. Monitoring was largely restricted to growth measurements in over 500 Permanent Sample Plots and this provided mensurational science with invaluable data for nearly 100 years. By comparison, biogeochemical and ecophysiological understanding of forest ecosystems remained poor, and so was the infrastructure to perform such scientific enquiry.

The advent of forest monitoring in the 1980s, due to concerns about the effects of 'acid rain', changed this position in several ways. Firstly, it provided real opportunities to make measurements on a large range of environmental 'driver' and 'response' variables through the forest canopy and into the soil beneath. Secondly, frequent repeated measurements allowed the development of understanding of the dynamic and interrelated nature of forest processes. Thirdly, the evolution of a pan-European monitoring process facilitated the development of a shared conceptual model of forest biogeochemistry, and this benefited UK science immeasurably. Fourthly, requirements for standard or common analytical methodologies, coupled with rigorous Quality Assurance procedures, increased UK laboratory capabilities significantly.

In recent years, Forest Research scientists have used the European forest monitoring network to explore a range of issues, including the trends in atmospheric pollutants and their effects on the forest ecosystem, the dynamic nature of the control on soil chemistry from the tree canopy, the importance of forest soils for carbon sequestration, and the effect of management operations, and of the incidence of pests and pathogens in influencing the size and direction of carbon fluxes. The likely influences of climate change have also been explored, notably by using a combination of monitoring and modelling. The Level II network has even been used by archaeologists interested in studying the stability of various types of buried artefacts, such as pottery, metal and glass objects. There is no doubt that without the bedrock of forest monitoring, little of this important work would have been possible.

New developments have built on pan-European monitoring foundations. For example, around the Alice Holt intensive monitoring site, a 'Research Forest' has been established, attracting co-operative scientific studies with leading universities. We have installed a gas flux tower, now with over 11 years data, which is integral to our increasing understanding of forest ecophysiology and energy, water and carbon dynamics. Coupled with monitoring of carbon dioxide fluxes from soil and in some cases the whole stand, we have also begun to measure methane and nitrous oxide fluxes at some of these Level II sites. Real-time monitoring is an important component of the suite of monitoring activities because it enables us to harness the power of process models, vital for a satisfactory understanding of the likely effects of climate change. Coupling these data with new approaches, such as use of cameras for monitoring canopy development is adding substantially to our quantitative understanding of canopy process, and will help link across to wider-scale remote sensing.

Today's main challenge for forest monitoring in the UK is to continue to demonstrate its relevance and value-for-money. The 'Ecosystem Services' framework appears the most versatile and policy-attractive way, based as it is upon the whole range of goods and services that forest ecosystems can provide, for the benefit of mankind. Such a framework can also facilitate integration of detailed scientific monitoring with that provided by census or inventory. Further work is also underway to explore how 'citizen science' can play a part in gathering relevant forest monitoring data, how to integrate ground-based monitoring activities with remote sensing information and how to harness existing monitoring platforms to provide an effective surveillance system for new and emerging forest pests and pathogens.

Poster abstracts

John Derome at Level II birch plot, Finland.

Intensive monitoring of forests on Olkiluoto Island

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Olkiluoto Island on the western coast of Finland has been selected as a repository site for spent nuclear fuel in Finland. Forest investigations carried out at Olkiluoto since 2002 aim at monitoring the state of the forest ecosystems, quantifying Olkiluoto-specific processes taking place in the forests producing input data for the safety assessment of spent nuclear fuel disposal, and following possible changes in forest condition resulting from the intensive construction activities currently taking place in the area. The forest investigations form a part of the monitoring programme implemented on Olkiluoto Island under the management of Posiva Oy. The monitoring system consists of several overlapping levels of intensity (Fig. 1). At the first level changes in land-use are followed by interpreting aerial images. The second level is for vegetation-type mapping including also forest resources. The third monitoring level comprises a grid of systematically located plots the purpose of which is to describe biomass distribution of forests and to monitor growth and other changes in tree stands (FET). Part of the FET plots has been selected for describing soil properties, vegetation composition and nutrient concentrations of plants and trees. The last two levels (MRK and FIP) comprise plots where observations are made daily or even hourly. Hence, the intensity of the sampling efforts increases towards the sixth monitoring level (Fig. 1). Here we report selected recent results obtained in forest intensive monitoring plots (MRK and FIP plots). In general, the deposition levels in 2009 in the open area and in stand throughfall were quite comparable to those in the earlier years, although S and Ca depositions were somewhat higher in the open area than in earlier years. Also the soil solution quality in 2009 was quite comparable to that in the earlier years. The NH_4-N and NO_3-N concentrations were low at all depths in the mineral soil of the FIP plots. There appears to be a gradual decrease in sulphate concentrations in the mineral soil during the monitoring period. Annual total litterfall production was smaller in 2008 than in 2007. The most notable differences between the plots were detected in Al and N concentrations in litterfall. Al concentration was higher in living pine needles than in spruce needles. High Al and Fe concentrations were found in remaining litter, and are most likely due to soil dust. The average defoliation levels of pines and spruces indicated good crown condition: the pines were classified as non-defoliated and the spruces as slightly defoliated. Monthly transpiration in the Norway spruce-dominated stand was clearly lower in 2009 than during 2007–2008. The minirhizotrone images filmed in 2009 in the FIP stands showed that most of the roots observed as new within the two first growing seasons were alive in 2009.

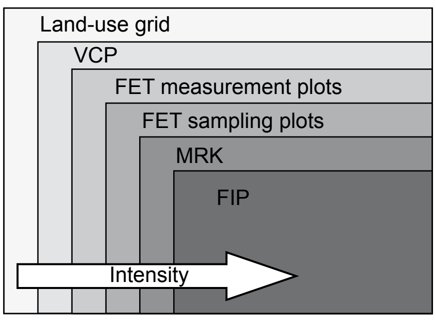

Figure 1. Forest monitoring levels at the Olkiluoto site.

References

Aro, L., Derome, J., Helmisaari, H-S., Hökkä, H., Lindroos, A-J. & Rautio, P. 2010. Results of forest monitoring on Olkiluoto Island in 2009. Posiva Oy, Working Report in preparation.

A vision for forest inventory and monitoring in Europe

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Forests deliver a vast array of products. Demands from the forests of Europe increasingly include environmental goods and services, recreational opportunities, and other amenities. These are in addition to the traditional timber products needed to sustain timber industry. Decision making in forestry must be based on reliable, current and consistent information on the extent and nature of its forests to enable the sustainable management of these resources. Forest inventory and monitoring must be able to answer questions such as how much forest exists, where it exists, who owns it, and how it is changing. Furthermore, the monitoring data are used to determine how the trees and other forest vegetation are growing and how much has died or has been removed in recent years. Sound decision making should be based on information from forests statistics and forest ecosystem monitoring. Forest inventory and monitoring have been ongoing in Europe for decades, even centuries in some countries. The primary purpose of forest inventories has been to provide accurate information for forest management, forest industry investment planning, and to assess the productivity of forests. The National Forest Inventories (NFI) are evolving to meet continuously increasing international agreements and commitments. A lack of harmonisation across inventory approaches in Europe has so far prevented a true European Forest Inventory although the ENFIN process is addressing this at present. Forest condition monitoring emerged as another important issue when climate change and air pollution led to declines in sensitive forest ecosystems and resulted in a range of national and transboundary monitoring programmes today. This poster outlines a framework for European forest monitoring combining National Forest Inventories with an existing network of agreed international reference methods. A future monitoring system should develop a consistent approach to forest inventory across the countries of Europe. This includes harmonised information on forest resources from National Forest Inventories based on national plot design, annual systematic measurement of a proportion of plots in each country and measures relating to forest ecosystem function, condition, and health.

Automatic digital cameras for phenology observations lead to higher quality assessments

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Although phenology assessments have been a part of the ICP Forests programme now for over 10 years, they have in actual fact been carried out on only a very limited number of Level II plots. The main reason for this is that making the observations is very time consuming, especially during the critical phases when the observations should be made on an almost daily basis. As most of the Level II plots are located in relatively isolated background areas, in practice this is almost impossible.

During recent years a number of new techniques based on automatic digital camera systems have been introduced. This makes continuous observation possible without having to visit the plot at frequent intervals. There are several other advantages to the use of cameras that improve the quality of the phenology assessments.

The use of cameras means that the actual assessments are based on digital photos. As a result, the same person can make the assessments on different plots, thereby eliminating the so-called "observer effect". Because the photos are in digital form they can be saved for a long time, thus increasing the accuracy of comparisons between years and/or between countries or regions. If the cameras are operating during the whole growing season, then the time when damage occurs (e.g. colour changes as a result of drought) can be determined much more precisely.

There are, of course, also some limitations related to the use of cameras. The number of trees on the plot that can be selected for assessment depends on the position of the camera. The type of forest may also set limitations. For example, dense conifer stands are difficult to assess, especially from below. As is the case for manual assessment in the field, making the assessments on the basis of digital photos also requires training, as well as knowledge of the tree species in question and its phenological stages. Finally, there is always the possibility of technical breakdowns and problems.

The use of digital cameras is now being promoted and tested on a European scale within the EU/Life+ FutMon (Further Development and Implementation of an EU-Level Forest Monitoring System) project under demonstration action D1 "Tree vitality and adaptation". Within the project this method will also be compared with traditional techniques.

Properties of Finnish forest soils based on BioSoil data

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In 'BioSoil' project 630 sample plots distributed evenly over the forested land area of Finland (263 000 km^2) were measured in 2006. As a general conclusion of carrying out such a large project, we can say that all phases of the project, starting from planning of the survey, followed by execution of the field work, sample pretreatment, laboratory analysis, data storage and ending to data management were equally important in order to produce correct and reliable data. In practical field work it was seen that despite of good planning, we can meet some almost unsolvable measurement challenges like the estimation of the amount of stones in soil. When calculating the amounts of elements per hectare, the estimate of the proportion of the stone volume of the total soil volume has a large effect on the accuracy of the estimate. In addition to the soil samples, also samples of ground vegetation were taken.

From the measured soil chemical properties we have produced national averages of nutrient and carbon contents in soils representing different forest site types. Soil samples have been taken from exactly the same locations 11 to 20 years before BioSoil. Based on the earlier measurements on the sites we have produced an estimate of the amount of annual carbon accumulation into the Finnish upland forest soils. This value will be used as a background information in developing the national greenhouse gas reporting system.

At the moment we are preparing an internet version of the BioSoil data under a working title 'A deeper insight into Finland'. In the interface the user can click on any of the 630 dots on the map of Finland representing all sites measured in BioSoil and find a photograph of the soil profile and a general picture of the stand and canopy cover. Also some information of the measured soil properties and ground vegetation will be included in this interface.

We are also using some novel data analysis methods like data mining and self organizing maps to find out some general structures of the ground vegetation species at the sites and combine this information with the similar analysis done for the measured soil properties. We have also planned to use material representing a larger geographical area than Finland for the data mining.

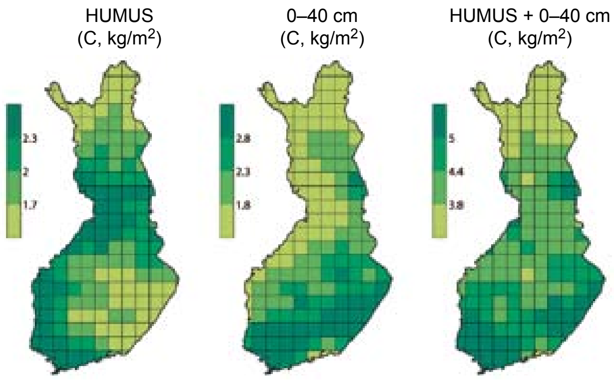

Figure 1. The distribution of soil carbon storages in Finnish forest soils. The low carbon content in Eastern Finland can be related in previous land use practices in that area.

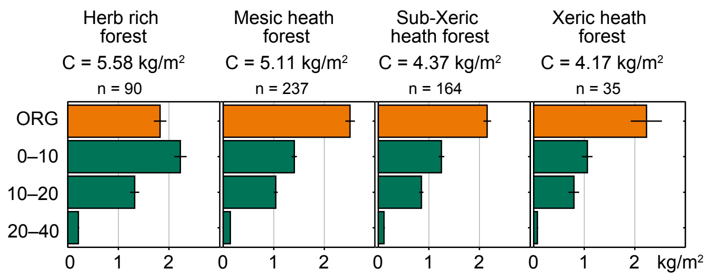

Figure 2. The vertical distribution of soil carbon storages in different site fertility classes.

Lapland forest damage project – the first attempt of Russian-Finnish scientific cooperation in the field of forest conservation

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The first time we met John Derome in 1990 in Rovaniemi where we have been invited by colleagues from Finnish Forest Research Institute. We have presented the results of our study concerning the influence of Montchegorsk smelter complex air pollutions on the environment of the Kola Peninsula. We familiarized ourselves with forest study and monitoring techniques used by Finnish scientists at the Rovaniemi Research Station. Just during this trip we made a joint decision to include Soviet scientists in the Lapland Forest Damage Project. Next summer a group of Finnish specialists under the leadership of John Derome from one hand and Russian ecologists headed by Vyacheslav Nikonov from the other started our joint work. We founded monitoring areas in pine forests at different distances from Severonikel complex and near Finnish-Soviet border. John was interested in our results of water migration of chemical elements through undisturbed soils study. We have shown how we search places for lysimeters installation and this was taken into account during mounting equipment in the areas of the forming monitoring network.

During a work and during a rest John was very friendly and tactful man. He understood people very well and had a rare gift: he could determine peculiarities of any person's character after a brief communication. As he told, this feature appeared after he studied Finnish language for several years and very attentively observed people whom he spoke with. He, as they say, felt people. Once there was an occurrence when we collected snow samples at the areas founded during the summer. It was very cold. Two Russian men were standing on the road. John loaded the samples to the car and suddenly ran to the men. And we saw that he gave them some whisky. They were quite surprised and pleased. Remembering such episodes like a small lecture delivered by him for young ecologists in 1995 and his serious answers to their non-chidish questions in 1995 or our meeting in 2009 at the anniversary of INEP we smile with love and tenderness.

Figure 1. Meeting at INEP 20 years anniversary. From left to right : Natalia Lukina, John Derome, Zina Jevtjugina, Jelena Kruglikova.

References

Jevtjugina, Z. 1994. Peculiarities of water migration of chemical elements in the landscapes under air-technical pollution, Preprint, Apatity.

Jevtjugina, Z. 1991. The atmospheric pollution load on forest ecosystems in the central part of the Kola Peninsula Research into forest damage connected with air pollution in Finnish Lapland and the Kola Peninsula of the U.S.S.R. Eds: Tikkanen, E. and Varmola, M. A seminar held in Kuusamo, Finland 1990, 132–141.

Kruglikova, J. 1991. The chemical composition of wild berries subjected to atmospheric industrial pollution in the Kola Peninsula. Eds: Tikkanen, E. and Varmola, M. A seminar held in Kuusamo, Finland 1990, 153–157.

Quality improvement of the laboratories of the ICP Forests program and the FutMon project

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To improve the comparability and evaluability of the European analytical data of the ICP Forests program and the FutMon project by advancing the quality of the laboratories the Working Group QA/QC in Laboratories was installed within the ICP Forests program.

After several years of work the analytical parts of the ICP Forests manual have been totally revised and unqualified methods have been eliminated. A review of possible checks and other helps for quality assurance and control in laboratories has been compiled and published. Meetings of the heads of the labs have been organized to exchange analytical knowledge and discuss analytical problems and solutions. A helping program for laboratories with problematic ring test results has been organized with bilateral visits of the labs and active help. The use of reference methods, different quality checks like control charts or ion balances and the participation in ring tests has become mandatory within the ICP Forests program and the FutMon project.

The most important step to force quality assurance and control was the introduction of regularly ring tests for water, soil and plant samples. In the meantime 6 soil, 4 water and 12 foliar ring tests have been organized within the ICP Forests program and FutMon project. From the results of these ring tests the development of quality in the labs can be seen. In Fig. 1 the results of the water ring test are mapped. The percentage of results out of the tolerable limits has been reduced over 8 years from 20–60% to 5–30%.

The same trend can be seen for the results of the last 4 soil ring tests in Fig. 2: the coefficient of variation (CV in %) for the results of all participants for the shown parameters lowered over 7 years from 15–65% to 10–35%. For the foliar ring tests (Fig. 3) the trend towards better results reached already in 2005 a level of 3–10% results out of the tolerable limits. It is difficult to improve further beyond this level.

The comparability and quality of the soil analyses are inferior to those of water and plant analyses as supported by the soil ring tests. But also the quality of water analyses can still be improved. Therefore regularly ring tests are still important for the improvement of the quality of analyses in the ICP Forests program.

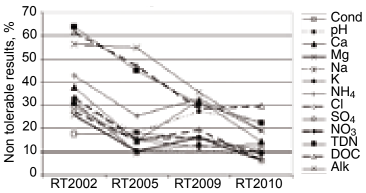

Figure 1. Development of the non tolerable results of the ICP Forests / FutMon water ring tests (RT) 2002–2010 for all evaluated parameters.

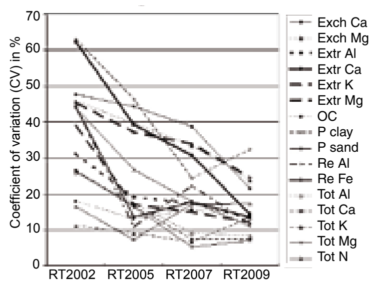

Figure 2. Development of the coefficient of variation (CV, in %) for selected parameters of the ICP Forests/ FutMon soil ring tests (RT) 2002–2009 for all evaluated parameters.

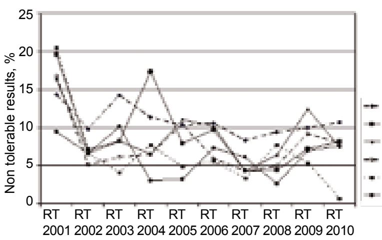

Figure 3. Development of the non tolerable results of the ICP Forests/ FutMon foliar ring tests (RT) 2001–2010.

We want to thank the EU for funding this project (LIFE 07 ENV/DE/000218).

Results and benefits from the FutMon project in Latvia

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During the last decades different aspects of changing climatic conditions have become increasingly important also for the forest sector. Continuous and systematic information about overall forest health and response of the forest ecosystem to the air pollution and climate change is therefore of major importance. In Europe, the main tool to provide such information since 1986 is the International Co-operative Programme on Assessment and Monitoring of Air Pollution Effects on Forests (ICP Forests). ICP Forests Level I forest monitoring in Latvia is implemented since 1990, but ICP Forests Level II – since 2004.

In 2009 in close collaboration with ICP Forests the project Further Development and Implementation of an EU-level Forest Monitoring System (FutMon) was launched. This project aims at the creation of a pan-European forest monitoring system which can serve as a basis for the provision of policy relevant information on forests in the European Union and is carried out by 38 beneficiaries from almost all EU member states, including Latvia represented by Latvia State Forest Research Institute "Silava".

In Latvia, following actions of the project are implemented:

- L1 – Creation of a large-scale representative monitoring grid. In 2009 a sub-set of National forest inventory (NFI) plot was selected for further forest health monitoring. Using the information provided by the State forest service these new plots are as similar to the old Level I plots much as possible; the main indicators to ensure similarity are dominant tree species, forest site type and stand age.
- L2 – Large scale representative monitoring, including observations of forest health conditions either on the old Level I plots or the new FutMon plots (L2a) and NFI field studies in order to test reference assessment methods and develop, test and enhance bridging functions for a set of core variables (L2b). In summer of 2009 and 2010 forest health observations were carried out on 115 new FutMon plots. In parallel, observations of forest health condition were continued by the State Forest Service on the old Level I plots. The results from the old and the new plots were found to be comparable. Core variables like forest land, other wooded land and volume of small trees were selected for the testing and development of bridging functions.
- IM1 – Latvia maintains one Level II monitoring plot, where observations of quantity and quality of depositions and soil water are carried out on regular basis, as well as extended evaluation of health conditions and increment of trees, structure of vegetation and quantitative characteristics of litter. All observations are carried out using methodology accepted by the ICP Forests. Regular monitoring of air quality and meteorological conditions is carried out since 2008.

Main results and benefits from participation in the FutMon project are following.

1. Integration of forest health monitoring in the National forest inventory.
2. Increased capacity of laboratories and field staff, networking activities within and outside the project tasks as well as access to broad range of reference materials for the forest health studies.
3. Possibilities for a more effective dissemination of information both in national and international level.
4. Increased possibilities for international collaboration.

Comparison of the harmonized and national deposition collectors in Finland

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The aim of this study was to compare the deposition results for the snow-free period obtained using the national deposition collectors and so-called harmonized deposition collectors. The national collector is a funnel type collector (diameter 20 cm) and placed 0.8 m above the ground surface. The national collectors have been used in deposition monitoring since 1996 in the EU/UN ECE ICP Forests Level II network in Finland (e.g. Lindroos et al. 2007). The harmonized collector has been developed within the EU Life+ project FutMon, and it is tested in participating countries of the FutMon project as a part of the action called 'Harmonizing deposition samplers'. The harmonized collector is also a funnel type collector (diameter 16 cm) and it is placed 1 m above the ground surface. The collectors were compared in an open area close to the forest stand (bulk deposition, BD) as well as within the stand (stand throughfall, TF). The comparison of the national and harmonized collectors took place on the Norway spruce sample plot located in eastern Finland (plot nr. 17, Punkaharju, stand age 75 years). The experimental setup and sampling procedure followed the national practices in the deposition monitoring with the exception that the number of the TF collectors was higher than normal in national monitoring. There were 3 collectors of both types in an open area (BD) and 30 collectors within the stand (TF). In addition, 30 TF collectors were compared with the TF sample collected using 20 national collectors, which is a commonly used practice in Finland. The BD and TF samples were collected every second week, and the samples were combined to give one sample per 4 week period. The amount of precipitation and concentrations of chemical parameters were determined in a similar way to the FutMon/ICP Forests programme. The samples were collected during the snow-free periods from the beginning of July 2009 until the end of August 2010. The preliminary results showed that both types of deposition collectors (national and harmonized) placed in an open area and within the stand using the national sampling grid gave very similar amounts of precipitation (mm) for each of the 4-week periods. This result is very encouraging from the point of view of the national collection system used in Finland. In the poster, the results of the deposition loads of the different chemical parameters on the forest (BD) and forest floor (TF) are presented for the national and harmonized system, and the results are compared between the two types of samplers.

Reference

Lindroos, A.-J., Derome, J. & Derome, K. 2007. Open area bulk deposition and stand throughfall in Finland during 2001-2004. Working Papers of the Finnish Forest Research Institute 45: 81-92.

Soil microbial biomass and community structure in organic horizons of boreal coniferous forests along a climatic gradient

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The aim of this study was to explore the effect of climate, fertility level and soil organic horizon on the soil microbial community structure in boreal coniferous forests.

For the study we chose twelve plots, half of which were located in the north boreal zone and the other half in the south boreal zone. Eleven of the plots are a part of the UN-ECE ICP Forests intensive monitoring network, with one extra plot (mesic plot in Sodankylä). The forest sites represent two different fertility levels: mesic forests dominated by Norway spruce (*Picea abies* (L.) Karst.), and sub-xeric forests dominated by Scots pine (*Pinus sylvestris* L.).

For the phospholipid fatty acid (PLFA) analysis, four organic layer cores (diameter 6 cm) were taken at even distances along each of the four edges of the 30 x 30 m square plot in August 2006. In the laboratory F and H horizons of each organic layer sample were carefully separated from each other and the four samples taken from the same edge of each plot were pooled and sieved (mesh size 4 mm) resulting in four F horizon and four H horizon samples from each plot.

The microbial community structure was determined by means of phospholipid fatty acid (PLFA) profiles. The sum of all 39 PLFAs (PLFAtot) was used as an index of living microbial biomass. The sum of PLFAs considered to be predominantly of bacterial origin was used as an index of the bacterial biomass (PLFAbact), and the amount of 18:2ω6,9 was used as an indicator of fungal biomass (PLFAfung).

The microbial biomass (g^{-1} OM) in terms of PLFAtot was significantly higher in the H than in the F horizon. However, the horizon *NS (north/south) was also significant, obviously because in the northern mesic sites the difference between H and F layers was only minor. PLFAbact followed similar pattern. PLFAfung showed no significant differences between site type, NS or layer but the interaction layer*NS was nearly significant due to the fact that in the north the F layer showed a slightly higher PLFAfung than the H horizon.

Because the H horizon is generally thicker than the F horizon, PLFAtot, PLFAbact and PLFAfung were always clearly higher in the H layer than in the F layer, when the results were calculated on an areal basis (m^{-2}). In addition, these variables showed generally higher values in the southern plots than in the northern plots. In the case of PLFAbact the interaction term layer *NS was significant, indicating that the difference between the H and F layer was greater in the south than in the north. The ratio PLFAfung:PLFAbact was always significantly higher in F than in H and in the north than in the south.

The microbial community structure differed clearly between F and H horizons, as well as between the mesic and xeric sites, although in the south the separation between the two fertility levels was not as clear as in the north.

Above and belowground N stocks in coniferous boreal forests in Finland

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Boreal forests store large amounts of carbon, which can be sensitive to temperature changes (Kauppi et al. 1995, Liski and Westman 1997). Nitrogen (N) is usually the growth-limiting factor in forest ecosystems and C and N cycles in terrestrial ecosystems are therefore tightly linked. As a result, predicting and modelling the effects of global warming, e.g. on C sequestration, also require information on the fluxes and pools of N. Long-term monitoring studies, such as those carried out on the UN-ECE ICP Forests/EU Forest Focus and Life+ FutMon Level II network, serve as a reliable source of information for use, e.g. in larger-scale modelling of changes in nutrient budgets and stocks caused by environmental changes. Although N budgets have been reported before, there is a need for better data in several ecosystem compartments, particularly root litter, woody detritus dynamics, coniferous foliage litter and N budgets (Nalder and Wein 2006). The data for this study were collected in 7 Scots pine (*Pinus sylvestris* (L.)) and 8 Norway spruce (*Picea abies* (L.) Karst) stands during 1998–2006. The sites belong to the Finnish network of intensively monitored forest plots (Level II) and are mostly located in conventionally managed forests. The following tree fractions were included in this study: needles, branches, dead branches, stems, bark, stump roots and fine roots. We also present the understorey N stocks, total N stocks in the litter and humus layer as well as in the mineral layer.

The N stocks in the pine stands were, on average, 35% lower than in the spruce stands, which is expected because spruce stands usually grow on more fertile sites than pine stands. More N was stored in the southern forest ecosystems than in northern ecosystems. This difference was exceptionally noticeable between northern and southern spruce stands. On average, the southern pine stands contained over 30% more nitrogen than the northern stands. More N was stored in the pine stems (13%) than in the spruce stems. Although the stems accounted for the major proportion (28–74%) of the total tree biomass in the stands, the branches (12–42%) and needles (11–34%) represented the dominant stocks of N in the tree biomass in both the pine and spruce stands. The N stock in the fine roots accounted for only a small proportion of the N stock in stand biomass (3.31–17.70%). According to Helmisaari (2002), however, this pool accounts for a major part of the N used for annual biomass production (45 kg ha^{-1}, 45–63%, in mature pine stands). The proportion of needles, branches, stumps and coarse roots, the logging residues that can be potentially used for bioenergy production, of the N in tree biomass were the largest in northern spruce stands (67±4%) and smallest in southern pine stands (53±1%).We will further analyse the data to study the N stocks in the understorey vegetation and individual soil layers and N fluxes.

References

Helmisaari H-S., Makkonen K., Kellomäki S., Valtonen E. & Mälkönen E. 2002. Below- and above-ground biomass, production and nitrogen use in Scots pine stands in eastern Finland. Forest Ecology And Management 165: 317-326.

Kauppi P.E., Tomppo E. & Ferm A. 1995. C and N storage in living trees within Finland since 1950s. Plant And Soil 169: 633-638.

Liski J. & Westman C.J. 1997. Carbon storage in forest soil of Finland.1. Effect of thermoclimate. Biogeochemistry 36: 239-260.

Nalder I.A. & Wein R.W. 2006. A model for the investigation of long-term carbon dynamics in boreal forests of western Canada - I. Model development and validation. Ecological Modelling 192: 37-66.

Analysis of the changes in the crown condition of conifers in the extensive monitoring plot network in Finland during 1995–2008

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We describe the changes of parameters depicting overall forest health (defoliation, discolouration, biotic and abiotic damage) during 1995–2008 in Finland.

Our results show no evidence of a widespread forest decline. The main causes of mortality were wind, snow and decay fungi (*Heterobasidion* sp.). The peaks in the mean annual mortality values (maximum 0.53% in spruce) were due to the larger number of trees broken by storms. About one fifth of the defoliation could be attributed to abiotic or biotic damage, and there were strong local correlations, e.g. between the changes in defoliation and the degree of pine sawfly damage. The temporal and spatial patterns in the incidence of the most important causes of damage could be revealed in the extensive forest health monitoring plots. These included Scleroderris canker (*Gremmeniella abietina*), pine shoot beetles (*Tomicus* sp.), and pine sawflies (*Neodiprion sertifer, Diprion pini*) in Scots pine and rust fungi (primarily *Chrysomyxa ledi*) in spruce. Symptoms attributed to drought (discolouration) increased strongly during 2006 in Scots pine in southern Finland.

The average defoliation degree of pine was 10.6% and that of spruce 20.0%. The changes in mean defoliation were usually very small between years in the whole country. The variation between the years was only 0.2 to 0.5% of the total variation. The mean age of the stand explained more than 50% of the between-plot variation in the defoliation degree.

In addition to the description of the data, several statistical methods were used to analyze the spatial and temporal patterns in these parameters. According to spatial autocorrelation analysis (Moran's I index), spruce defoliation data was more clustered than pine defoliation data. Spatial synchrony between plots was weak in both tree species, and weaker between pine than between spruce plots. Hot-spot analysis accentuates the areas of small, but parallel change, which may be uncovered by normal spatial smoothing methods, and revealed both "hot" and "cold" spots in the defoliation data. Trend analyses revealed significantly different patterns of change in the defoliation in different parts of the country. On both pine and spruce plots, the largest increase occurred in southernmost Finland, as well as in western Finland in pine and south west Lapland in spruce.

The changes in the defoliation of pine correlated very significantly, but negatively, with the reduction in sulphur deposition from 1995 to 2005, i.e. the increase in defoliation was the greatest in the area where the reduction was the largest, in southernmost Finland.

Boreal forest mosses as indicators of nitrogen deposition studies on the Level II plots

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The ectohydric mosses obtain most of their nutrient supply from rainwater and dry deposition, which makes them suitable for monitoring air pollutants. In the surveys carried out in Finland in 1990–2005, the N concentration in mosses (*Hylocomium splendens, Pleurozium schreberi*) correlated relatively well with the modelled N deposition. However, the concentration varied in relation to the characteristics of the tree stand. In the project "Boreal forest mosses as indicators of nitrogen deposition in Finland" (2009–2013) the suitability of the mosses as bioindicators will be ivestigated more accurately. Studies will be made on the plots of the National Forest Inventory (NFI) and on the intensive monitoring plots of forest ecosystems (Level II) in close association with the FutMon project. On the Level II plots we will investigate the effects of N deposition on the N concentration in mosses, N-fixation by cyanobacteria in mosses and competition between moss species. This paper contains preliminary results of the N concentration in mosses in relation to N deposition on the plots in 2009.

Moss samples (*H. splendens*, *P. schreberi*) were collected from the gaps between the trees monthly (V–X) on the six Norway spruce plots and on the five Scots pine plots in different parts of the country (Fig. 1a). Three annual growth sections were separated for nitrogen analysis. N deposition (N_{tot}, NO_3-N, NH_4-N) was also measured at 4-week periods on the same plots (bulk deposition in open area and stand throughfall). Mean N concentrations (V–X) in *H. splendens* were a little higher on the spruce plots (0.58–1.70 mg/kg) as in *P. schreberi* (0.54–1.51 mg/kg; Fig.1b). Furthermore, N concentrations of both moss species and total N deposition on the spruce plots were slightly higher than on the pine plots. The N concentration in mosses correlated better with total N, NO_3-N and NH_4-N values in stand throughfall (= high correlation) than with those in the open area (= high or moderate correlation). The results reveal that N concentrations in mosses firstly reflect N deposition in stand throughfall, although the moss samples are collected from the gaps in the forests.

References

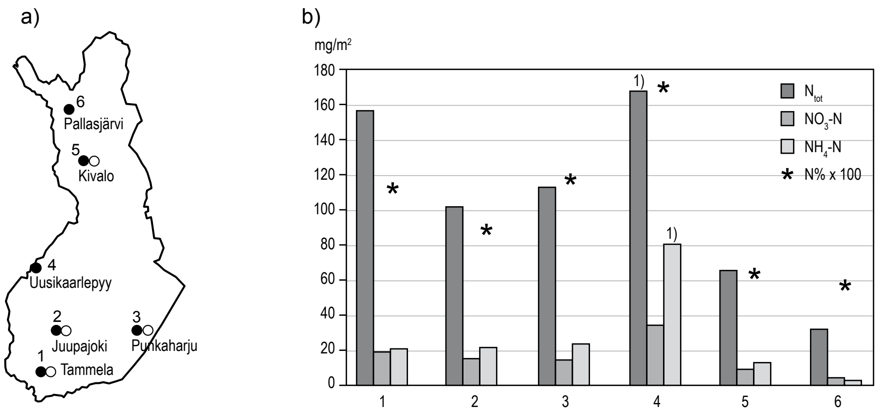

Figure 1. a) Intensive monitoring plots (Level II) used in studies, ● Norway spruce plot, ○ Scots pine plot, b) N concent in mosses and N deposition (N_{tot}, NO_3-N, NH_4-N) in stand throughfall on the spruce plots (in V–X), 1) estimation.

Poikolainen, J., Piispanen, J., Karhu, J. & Kubin, E. 2009. Long-term changes in nitrogen deposition in Finland (1990-2006) monitored used the moss Hylocomium splendens. Environmental Pollution 157:3091-3097.

Lindroos, A-J., Derome, J. & Derome, K. 2007. Open area bulk deposition and throughfall in Finland during 2001-2004. In: Merilä, P., Kilponen, T. & Derome, J. (eds.). Forest Condition Monitoring in Finland. National report 2002-2005. Working Papers of the Finnish Forest Research Institute 45:81-92.

Changes in forest vegetation in Finland during 1985–2006

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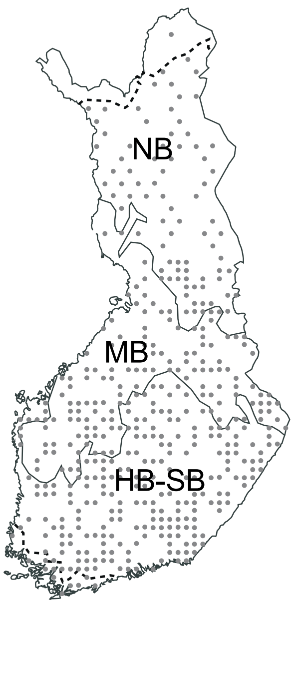
Understorey vegetation in 443 forested mineral soil sites (Fig. 1) (a subset of Finnish ICP Forests Level I plots) was surveyed in 1985–86, 1995 and 2006. This allows us to detect spatio-temporal changes that have possibly taken place in forest vegetation during the past two decades. The data include both unmanaged and managed stands.

Plant species were identified and their percentage cover was estimated on four sampling units (squares of size 2 m^2, i.e. 8 m^2 in total on each plot) positioned exactly on the same locations on each of the three occasions. For the present analysis, we calculated plot-specific averages of cover % and the number of species of six plant groups: tree seedlings and shrubs (height < 0.5m), dwarf shrubs, herbs, graminoids, bryophytes and lichens. Temporal changes in the cover % and the number of species in each plant group were analysed across three biogeographical zones in Finland.

In Southern Finland the results indicate a slight increase in the number of species in herbs and graminoids. Further, the cover and the species number of trees and shrubs in the field layer (height < 50 cm), have increased. On the other hand, the cover of lichens on nutrient-poor and xeric sites has decreased in the whole country (Fig. 2).

The main causes for these changes are found in forest management practices and in natural succession of the stands. In addition, in Southern Finland the effect of nitrogen deposition, accumulated in the forest ecosystems during the last decades, might have caused some eutrophication in vegetation. In Northern Finland it is probable that reindeer grazing pressure has had an impact on the decrease in lichen cover.

Our analysis will continue by examining plant community level changes using ordination and data mining methods. In this analysis we will include historical data from the early 1950s when understorey vegetation assessment was conducted as a part of the third National Forest Inventory of Finland. This will give a temporal trend of over half a century in Finnish forest vegetation changes.



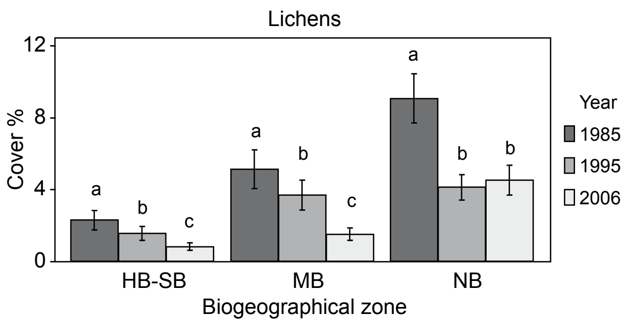


Figure 2. Total cover (%, mean ± SE) of terrestrial lichens (dominating groups *Cladina* spp., *Cladonia* spp. and *Cetraria* spp.) in 1985–86, 1995 and 2006 in the three biogeographical zones (Fig. 1). Different letters indicate significant differences ($p < 0.05$) between the years within each zone (paired t test).

Figure 1. The location of the plots in the hemiboreal-southern boreal (HB-SB, n = 229), middle boreal (MB, n = 133) and northern boreal (NB, n = 81) biogeographical zones in Finland.

Does decreased acidity have an effect on DOC concentrations in throughfall and soil water?

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"Acid rain" is largely related to the deposition load of the strong acid anion, SO_4^{2-}. As a result of air quality controls, SO_4^{2-} deposition throughout Europe has considerably decreased since the 1980s, when concerns about the declining forest condition were widespread. At the same time numerous studies have reported increased concentrations of dissolved organic carbon (DOC) in boreal lakes and streams in Europe and North America. Many different processes have been proposed to explain increased DOC concentrations, e.g. land use change, increased forest production, climate warming, and recovery from acidification due to reduced sulphur deposition. We wished to determine if decreased acid deposition (measured as SO_4^{2-} and acid neutralizing capacity, ANC) have had an effect on DOC concentrations in throughfall and soil water collected in boreal coniferous forests in Finland.

In this paper we report on the levels and trends in sulphur, nitrogen, chloride, base cation concentrations and ANC (the difference between the sum of base cations and the sum of strong acid anions, SO_4^{2-}, NO_3^- and Cl^- on an equivalent basis) and DOC concentration in throughfall and soil water collected in three stands in Finland; Valkea-Kotinen (VK), Hietajärvi (HJ) and Pesosjärvi (PJ). Data was collected during 1990-2007 as of a part of the long term monitoring programmes UN-ECE ICP-IM and ICP Forest. The studied stands are unmanaged, old stands with varying proportions of Scots pine, Norway spruce and deciduous trees (mainly birch). Deposition was highest in the southern site (VK) and lowest in the northern site (PJ). Around 1990, when the sulphur deposition peaked, loads were at their highest between 15 and 20 kg ha^{-1} $year^{-1}$ in Finland. Throughfall was collected with 8–20 collectors biweekly during the growing period and monthly during the winter. Soil water was collected with suction or zero tension lysimeters during the growing period. Chemical analyses were conducted according to ICP IM and ICP forest manuals.

Results from the 16-year period showed that ANC values in throughfall at our stands had a significantly increasing (positive) trend, being the greatest at VK. The changes had mainly been brought about through a reduction in SO_4^{2-} and H^+ concentrations and increasing base cation concentrations. DOC concentrations also showed an increasing trend in all sites, significantly at VK and PJ. In soilwater DOC concentration varied considerably within and between years in both depths (20 cm and 40 cm), being higher at a 20 cm depth. At HJ and PJ there was a significantly increasing trend, while at VK a decreasing trend was observed. ANC values decreased slightly at both depths at VK and PJ at 40 cm, which was the opposite trend to what we expected, indicating that soil water was continuing to acidify at those sites. Declined base cation concentrations account for the decrease in ANC values.

In summary the increase in DOC concentration coincides with decreasing SO_4^2 concentration, indicating the SO_4^2 concentration is possibly an important driver of DOC release from the canopy and the organic soil layer of some of these stands. Increased ANC values were connected to the increased DOC concentration in TF and some sites and depths in SW. In addition, a slightly increased amount of litterfall and consequently increased decomposition might partly explain the increasing trend in throughfall DOC concentrations.

Radiocesium in wild berries in Northern Finland

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The radioactive fallout in Finnish Lapland from the Chernobyl accident in 1986 was low, for ^{137}Cs in average 1000 Bq/m^2. The enrichment of radionuclides in the special food chains is however very effective. Arctic and subarctic terrestrial ecosystems are highly vulnerable to radioactive fallout due to high transfer rates in arctic environment. The impact of the Chernobyl deposition can still be noticed in the products from natural origin e.g. freshwater fish, wild mushrooms, game meat, reindeer and forest berries.

In this study the activity concentrations of ^{137}Cs in the different wild berries are presented in the eastern part of Northern Finland. The studied area covered approximately 50 000 km^2 and it consisted of 48 individual sample sites. The sample sites composed of a grid 30 km apart from each other. Altogether 191 samples (bilberry, lingonberry, cloudberry and crowberry) were collected by METLA, one sample per species from each sampling sites. The nuclides emitting γ-radiation were measured by STUK – Radiation and Nuclear Safety Authority. The sampling were carried out in 2005 and the analyses in 2008.

The data indicate that cloudberry, which is a species typical of Arctic ecosystems, has the highest ^{137}Cs activity concentrations and is relatively sensitive to radiocesium deposition compared to the other species. Cloudberry grows on wet, highly organic swamps, where existing conditions lead to high radiocesium plat uptake from soil. Bilberry grow on fresh heat, lingonberry and crowberry on dry heat, both habitats exists in the boreal forest where the organic layer is low and sand is often present under the organic horizon. The reduction in time of the ^{137}Cs content of Arctic berries is slow. Differences between concentrations in species are presented in graphics and the potential consequences to spatial variation can be seen on thematic maps.